



TENNESSEE DEPARTMENT OF

**EDUCATION**  
FIRST TO THE TOP

## Architectural & Engineering Design II

<b>Primary Career Cluster:</b>	Architecture & Construction
<b>Consultant:</b>	Rachel Allen, (615) 532-2835, <a href="mailto:Rachel.Allen@tn.gov">Rachel.Allen@tn.gov</a>
<b>Course Code(s):</b>	6039
<b>Prerequisite(s):</b>	<i>Architectural &amp; Engineering Design I</i> (6037), <i>Algebra I</i> (0842, 3102)
<b>Credit:</b>	1
<b>Grade Level:</b>	10
<b>Graduation Requirements:</b>	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Architecture & Construction courses.
<b>Programs of Study and Sequence:</b>	This is the second course in the <i>Architectural &amp; Engineering Design</i> program of study.
<b>Aligned Student Organization(s):</b>	SkillsUSA: <a href="http://site1.tnskillsusa.com/">http://site1.tnskillsusa.com/</a> Brandon Hudson, (615) 532-2804, <a href="mailto:Brandon.Hudson@tn.gov">Brandon.Hudson@tn.gov</a> Technology Student Association (TSA): <a href="http://www.tntsa.org">http://www.tntsa.org</a> Amanda Hodges, (615) 532-6270, <a href="mailto:Amanda.Hodges@tn.gov">Amanda.Hodges@tn.gov</a>
<b>Coordinating Work-Based Learning:</b>	Teachers are encouraged to use embedded WBL activities such as informational interviewing, job shadowing, and career mentoring. For information, visit <a href="http://tn.gov/education/cte/work_based_learning.shtml">http://tn.gov/education/cte/work_based_learning.shtml</a> .
<b>Available Student Industry Certifications:</b>	Autodesk Certified User or ADDA Apprentice Drafter
<b>Dual Credit or Dual Enrollment Opportunities:</b>	There are no known dual credit/dual enrollment opportunities for this course. If interested in developing, reach out to a local postsecondary institution to establish an articulation agreement.
<b>Teacher Endorsement(s):</b>	070, 157, 230, 470, 477, 531, 551, 552, 553, 554, 555, 556, 584, 585, 595, 596, 700, 705, 740, 760, or any other Occupational License endorsement with ADDA certified drafter or Autodesk certification
<b>Required Teacher Certifications/Training:</b>	ADDA Certified Drafter or Autodesk Certified Professional
<b>Teacher Resources:</b>	<a href="http://www.tn.gov/education/cte/ArchitectureConstruction.shtml">http://www.tn.gov/education/cte/ArchitectureConstruction.shtml</a>

### Course Description

*Architectural & Engineering Design II* is the second course in the *Architectural & Engineering Design* program of study. Students in this course build their skills in developing and representing design ideas using technical drawing and modeling techniques, and apply the design process to solve design problems. Upon completion of this course, proficient students will be able to use computer-aided

drafting (CAD) software to create multi-view, sectional view, auxiliary view, and three-dimensional drawings using industry standard dimensioning and notation. Students will connect drawings with actual physical layouts by building models based on drawings, creating drawings based on objects and other physical layouts, and using software to create basic three-dimensional models. In addition, students will continue compiling artifacts for inclusion in a portfolio, which they will carry with them throughout the full sequence of courses in this program of study. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects and Tennessee State Standards in Mathematics.\*

## Program of Study Application

This is the second course in the *Architectural & Engineering Design* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Architecture & Construction website at <http://www.tn.gov/education/cte/ArchitectureConstruction.shtml>.

## Course Standards

### Safety

- 1) Accurately read, interpret, and demonstrate adherence to safety rules, including but not limited to rules published by the Occupational Safety and Health Administration (OSHA), and state and national code requirements. Be able to distinguish between the rules and explain why certain rules apply. (TN Reading 3, 4, 6)
- 2) Identify and explain the intended use of safety equipment available in the classroom. Demonstrate how to properly inspect, use, and maintain safe operating procedures with tools and equipment. Incorporate safety procedures and complete safety test with 100 percent accuracy. (TN Reading 3, 4)

### Career Exploration

- 3) Research the postsecondary institutions (colleges of applied technology, community colleges, and four-year universities) in Tennessee and other states that offer architecture or engineering programs. Write an informative paper or develop an infographic identifying admissions criteria, the postsecondary programs of study, and the secondary courses that will prepare individuals to be successful in a postsecondary architecture or engineering program. Evaluate the tentative career plan developed in the introductory course in light of these findings, and update the career plan to reflect any new discoveries, citing evidence from the research. (TN Reading 1, 2, 3, 5; TN Writing 2, 4, 7, 9)

### Advanced Technical Drawing

- 4) Use computer-aided drafting (CAD) software to create two-dimensional drawings of advancing complexity, accurately incorporating symbols, notes, dimensioning, and line types to design drawings. Perform software operations such as utilizing sheets/layouts for printing, scaling viewports in sheets/layouts for printing, printing drawings to proper scale, outputting drawings

to electronic and paper media, and overlaying drawings on externally-referenced drawings. (TN Reading 3, 4; TN Math G-MG)

- 5) Use CAD software to create accurate multi-view drawings of objects of advancing complexity using orthographic projection, incorporating symbols, notes, dimensions, and line type (such as hidden lines to show internal or hidden features). (TN Reading 3, 4; TN Math G-MG)
- 6) Use CAD software to create pictorial drawings of advancing complexity, such as isometric, oblique, and perspective drawings. Attend to detail by using proper angles and ensuring holes, cylinders, prisms, and other features are in proper alignment and relationship to each other. Incorporate symbols, notes, dimensions, and line type according to industry standards. (TN Reading 3, 4; TN Math G-GMD, G-MG)
- 7) Create accurate sectional view drawings of advancing complexity (such as full, half, offset, broken-out, removed, and revolved sections), incorporating symbols, notes, and dimensions, using appropriate layout within title blocks, and appropriate drawing composition (including line weight and line type). For example, create a full section drawing of a mechanical part, hatching appropriate surfaces and using notation to indicate the cutting plane. (TN Reading 3, 4; TN Math G-GMD, G-MG)
- 8) Create accurate auxiliary view drawings of advancing complexity including depth, height, or width auxiliary views; partial auxiliary views; and auxiliary section views. (TN Reading 3, 4; TN Math G-GMD, G-MG)
- 9) Draw detailed, schematic, and simplified drawings of various types of threads and fasteners, including unified, square, and acme threads. Demonstrate the ability to accurately interpret industry-standard thread notes to calculate the thread pitch as well as lay out and construct the drawing. (TN Reading 3, 4; TN Math N-Q, A-CED, G-GMD, G-MG)
- 10) In teams, produce a complete set of project drawings including a completed assembly drawing and an exploded assembly drawing. Supplement assembly drawings with appropriate representations of individual components and a bill of materials as needed for the project type. Fully describe the design by selecting the most appropriate drawing type for the given component, including plan, section, and three-dimensional drawings. (TN Reading 3, 4; TN Math G-MG)
- 11) Demonstrate the ability to refine drawings based on critique from peers, instructors, and self-evaluation. Drawing on evidence from textbooks and other resources, evaluate the effectiveness of a drawing based on industry standards for technical drawing. Interpret and incorporate feedback when refining drawings. (TN Reading 2, 3, 4, 6, 7; TN Writing 5, 9)

### **Dimensioning**

- 12) Interpret industry standards to accurately apply dimensions, notes, and symbols on CAD drawings, including arranging dimensions, using various dimension styles and symbols, and avoiding redundancy. Demonstrate the ability to adjust annotation styles and sizes based on the

drawing type and scale. Define tolerance and give examples of general methods for noting tolerances on drawings. (TN Reading 3, 4; TN Math G-MG)

- 13) Research the American National Standards Institute (ANSI) and describe the goals of the organization and the impact it has on technical drawing, particularly for dimensioning a drawing. (TN Reading 2, 3, 4, 5, 7)

### **Introduction to Three-Dimensional Modeling**

- 14) Use three-dimensional modeling software to create a simple three-dimensional model. Interpret instructional materials to perform basic operations using three-dimensional modeling software. Instructional materials may include textbooks, instructional manuals, websites, video tutorials, and more. (TN Reading 2, 3, 4, 6, 7; TN Math G-GMD, G-MG)

### **Applications of Technical Drawing**

- 15) Understand how designs are communicated through different types of two-dimensional and three-dimensional drawings, physical models, and virtual three-dimensional models within various disciplines, such as architectural, civil, mechanical, electrical, and industrial design. Interpret symbols and notations within the context of each type. Use technology to create a visual display with supporting text to compare and contrast how different drawing types covered in the coursework are implemented in a variety of disciplines, drawing from examples in textbooks, industry journals, drawings created during the coursework, and other resources. For example, illustrate how the plan, orthographic projections, and section drawings of a residence compare with those of a machine part. (TN Reading 1, 2, 4, 7; TN Writing 2, 6, 9)
- 16) Interpret technical drawings to build a physical model of a design. Select and use the appropriate materials and tools to safely measure components and construct the model. Upon completion, use the technical drawings to check the model for accuracy. (TN Reading 2, 3, 4, 6, 7; TN Math N-Q; G-GMD, G-MG)
- 17) Building on techniques practiced in the introductory course, continue to measure, record, and use field measurements to create drawings of increasingly complex objects and layouts. For example, create an accurate half section drawing of an actual mechanical gear by measuring and examining the physical object in order to visualize and draw the section. (TN Reading 3, 4; TN Writing 2, 4; TN Math N-Q, G-MG)
- 18) Create two-dimensional plans for a simple three-dimensional object utilizing drawing techniques learned in the course, such as auxiliary drawing. Use the plans to build a rough study model of the object. Evaluate the model and revise the design on the basis of collected test data. For example, create a two-dimensional drawing of three-dimensional sheet metal design or package design as if the object were unfolded. Print the drawing on paper and construct a paper model of the object. Evaluate the model for inaccuracies and identify opportunities to improve efficiency of materials or construction. Use these conclusions to refine the design. (TN Reading 3, 4; TN Math N-Q; G-GMD, G-MG)

## Technology

- 19) Identify and demonstrate basic troubleshooting strategies related to fundamental hardware and software problems. Evaluate electronic media to diagnose and fix hardware and software problems encountered during the coursework. For example, consult software forums, tutorial videos, and other instructional materials to diagnose and correct a drawing that prints on paper differently than intended. (TN Reading 2, 3, 4, 5, 9)
- 20) Explain how technology has changed design throughout history, and identify current transitions occurring in design media, technique, and focus. Read and interpret trade journals, assessing the usefulness of each source, to describe the impact technology has had on a particular design discipline. For example, cite evidence from trade journals to explain the impact of three-dimensional printing on industrial engineering practices or the impact of building information modeling software on structural engineering practices. (TN Reading 1, 2, 3, 4, 5; TN Writing 2, 8, 9)

## Projects

- 21) Develop a project plan and use the design process to create a solution for moderately complex problem sets, utilizing both simple three-dimensional modeling techniques and detailed technical two-dimensional and three-dimensional scale drawings. Prepare a persuasive narrative to justify the design, describing the constraints of the design and defending how the design solves the identified problem(s). At the completion of the design process, publish the narrative and design and present the design to an audience, receive feedback, and critique the designs of other classmates. (TN Reading 3, 4, 5, 7; TN Writing 1, 4, 6; TN Math N-Q, G-MG)
- 22) Choose between alternate design solutions for a given design problem and justify the choices. Make a written case for selecting one design over another, highlighting the design features of each and citing resources to validate claims. Demonstrate the ability to pitch the idea to the client in a presentation, defending the design by pointing to specific features that meet the client's specifications. (TN Reading 1, 2, 4, 6, 7, 8; TN Writing 1, 4, 9)

## Portfolio

- 23) Update materials from coursework to add to the portfolio begun in the introductory course. Continually reflect on coursework experiences and revise and refine the career plan generated in the introductory course. Include written descriptions of drawing types and learning outcomes. (TN Writing 4, 5, 7, 9)

## Standards Alignment Notes

\*References to other standards include:

- TN Reading: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).

- Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
  - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3 and 10 at the conclusion of the course.
- TN Math: [Tennessee State Standards for Mathematics](#); Math Standards for High School: Number and Quantity, Algebra, and Geometry (pages 58-83).
  - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, algebraic, and geometric reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
  - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.